

What is claimed:

- 1           1.     A method of pasteurizing in-shell chicken eggs, comprising:  
2                 (1) placing the eggs in a heated fluid having a temperature of between  
3     about 128°F and 146°F;  
4                 (2) allowing the eggs to dwell in the heated fluid until there is a log  
5     reduction of at least 4.6 of any Salmonella bacteria within the eggs;  
6                 (3) removing the eggs from the heated fluid and into a gaseous  
7     atmosphere; and  
8                 (4) contacting the eggs with an antibacterial fluid containing an  
9     antibacterial agent.
- 1           2.     The method of claim 1, wherein the log reduction is about above 4.75.
- 1           3.     The method of claim 2, where the log reduction is about 6 to 12 logs.
- 1           4.     The method of claim 1, wherein the heated fluid is at different  
2     temperatures.
- 1           5.     The method of claim 4, wherein a first temperature of the heated fluid  
2     is about 139°F to 146°F, and a second temperature of the heated fluid is about  
3     130°F to less than 135°F and a third temperature of the heated fluid is about 135°F  
4     to 138°F.
- 1           6.     The method of claim 4, wherein the heat fluid is water and the water is  
2     contained in an elongated tank through which the eggs traverse from an entrance  
3     end of the tank to a middle zone of the tank and to an exit end of the tank.
- 1           7.     The method of claim 6, wherein near a bottom of the tank a plurality of  
2     jets are dispersed through which a jet fluid is passed from the jets into the water.
- 1           8.     The method of claim 7, wherein some of the jets are arranged

transverse to a major axis of the tank and one series of the transverse jets is spaced apart along the major axis from another series of the transverse jets.

9. The method of claim 8, wherein the jet fluid rises vertically in the water and to at least near a top of the water to provide a jet fluid wall in the water near each of the spaced apart series of jets, and between two such jet fluid walls a jet fluid walled compartment is formed.

10. The method of claim 9, wherein there are at least two jet fluid walled compartments along the major axis and at least two of the compartments are maintained at different temperatures.

11. The method of claim 10, wherein the jet fluid is a gas or liquid.

12. The method of claim 11, wherein the gas air and the liquid is water.

13. The method of claim 10, wherein at least three compartments are maintained at different temperatures.

14. The method of claim 13, wherein there are an entrance compartment, a middle compartment, and an exit compartment and the length along the major axis of the tank of the entrance compartment is from 0.1 to 0.3 the length of the tank, the middle compartment is from 0.3 to 0.7 the length and the exit compartment is from about 0.1 to 0.3 the length and the temperature within the entrance compartment is from 139°F to 146°F, the middle compartment is from 132° to less than 135°F and the exit end compartment is from 135°F to 138°F.

15. The method of claim 14, wherein the length of the entrance compartment is from about 0.1 to about 0.2, the middle compartment is from about 0.2 to 0.6 and the exit compartment from about 0.1 to 0.2 and the respective temperatures are from about 141°F to 143°F, 133°F to 134.5°F and 136°F to 139°F.

1           16.    The method of claim 1, wherein the antibacterial agent is any one of  
2   FDA Food Use approved bacteriacides.

1           17.    The method of claim 16, wherein the bacteriacide is selected from  
2   chlorine, bromine, ozone, hydrogen peroxide and quaternary ammonia compounds.

1           18.    The method of claim 16, wherein the antibacterial fluid is water.

1           19.    The method of claim 1, wherein the antibacterial fluid is contacted with  
2   the eggs and is also contacted with mechanical equipment handling the eggs  
3   subsequent to the eggs exiting the heated fluid.

1           20.    The method of claim 19, wherein the antibacterial fluid is sprayed onto  
2   the eggs and onto the mechanical equipment and prior to the eggs contacting the  
3   mechanical equipment.

1           21.    The method of claim 1, wherein after contacting the eggs with the  
2   antibacterial fluid the eggs are contacted with an egg pore sealant.

1           22.    The method of claim 21, wherein the pore sealant has an antibacterial  
2   agent therein.

1           23.    The method of claim 22, wherein the antibacterial agent is a FDA Food  
2   Use approved bactericide.

1           24.    The method of claim 21, where the pore sealant is selected from food  
2   grade polymers, waxes and soluble proteins.

1           25.    The method of claim 24, wherein the sealant is wax.

1           26.    The method of claim 21, wherein the sealant is sprayed onto the eggs.

1           27.    The method of claim 21, wherein after contacting the eggs with the  
2           sealant, an amount of sealant which remains on the eggs is at least equal to 90% of  
3           natural egg pore sealant removed from the eggs during the dwell of the eggs in the  
4           heated fluid.

1           28.    The method of claim 1, wherein the eggs exit the heated fluid with a  
2           log reduction of about at least 4.6 and while the eggs are in the gaseous  
3           atmosphere residual heat in the eggs increases the log reduction to at least 5.

1           29.    The method of claim 28, wherein the eggs are in the gaseous  
2           atmosphere for about 1.5 to 3.5 minutes.

1           30.    A method of pasteurizing in-shell chicken eggs comprising:  
2           (1)    placing the eggs in a heated fluid having temperatures between  
3           about 128°F and 146°F so as to heat the eggs, said heated fluid having a first  
4           temperature of about 139°F to 146°F, a second temperature from about 130°F to  
5           less than 135°F and a third temperature from about 135°F to 138°F, and wherein  
6           the first, second, and third temperatures of the heated fluid are maintained in  
7           separate zones of the heated fluid;  
8           (2)    allowing the eggs to pass through the first, second, and third  
9           temperatures in a time period which causes at least a log reduction of 4.6 of any  
10          Salmonella bacteria within the eggs; and  
11          (3)    removing the eggs from the heated fluid to a gaseous  
12          atmosphere and allowing the eggs to cool.

1           31.    The process of claim 30, wherein while the eggs are in the gaseous  
2           atmosphere, the eggs are contacted with an antibacterial fluid containing an  
3           antibacterial agent.

1           32.    The process of claim 31, wherein after the eggs are contacted with the  
2           antibacterial fluid, the eggs are contacted with an egg pore sealant.

1           33.    The process of claim 32, wherein the sealant has an antibacterial  
2 agent therein.

1           34.    The method of claim 30, wherein the eggs remain in the gaseous  
2 atmosphere until the eggs reach a final log reduction of at least about 5.

1           35.    The method of claim 34, wherein a final log reduction is up to about 12.

1           36.    The method of claim 30, wherein the heated fluid is water and the  
2 water is contained in an elongated tank through which the eggs traverse from an  
3 entrance end of the tank to a middle zone of the tank and to an exit end of the tank  
4 and near a bottom of the tank a plurality of jets are dispersed through which a jet  
5 fluid is passed from the jets into the water.

1           37.    The method of claim 36, wherein some of the jets are arranged  
2 transverse to a major axis of the tank.

1           38.    The method of claim 37, wherein one series of the transverse jets is  
2 spaced apart along a major axis from another series of transverse jets.

1           39.    The method of claim 38, wherein the jet fluid rises vertically in the  
2 water and to at least near a top of the water to provide a jet fluid wall in the water  
3 near each of the spaced apart series of jets, and between two such jet fluid walls a  
4 jet fluid walled compartment is formed.

1           40.    The method of claim 39, wherein there are at least three jet fluid walled  
2 compartments along the major axis and the three compartments are maintained at  
3 the first, second and third temperatures.

1           41.    The method of claim 40, wherein the jet fluid is a gas or liquid.

1           42.    The method of claim 40, wherein there are an entrance compartment,

2 a middle compartment and an exit compartment and the length along the major axis  
3 of the tank of the entrance compartment is from 0.1 to 0.3 the length of the tank, the  
4 middle compartment is from 0.3 to 0.7 the length and the exit compartment is 0.1 to  
5 0.3 the length.

1 43. The method of claim 42, wherein the length of the entrance  
2 compartment is from about 0.1 to about 0.2, the middle portion is from about 0.2 to  
3 0.6 and the exits from about 0.1 to 0.2 and the respective temperatures are from  
4 about 141°F to 143°F, 133°F to 135°F and 136°F to 137°F.

1 44. The method of claim 31, wherein the antibacterial agent is any one of  
2 FDA Food Use approved bactericides.

1 45. The method of claim 31, wherein the antibacterial fluid is contacted  
2 with the eggs and is also contacted with mechanical equipment handling the eggs  
3 subsequent to the eggs exiting the heated fluid.

1 46. The method of claim 45, wherein the eggs and mechanical equipment  
2 are sprayed with the antibacterial fluid and the mechanical equipment includes egg  
3 destacking equipment.

1 47. The method of claim 32, wherein the pore sealant has an antibacterial  
2 agent therein.

1 48. The method of claim 47, wherein the antibacterial agent is a FDA Food  
2 Use approved bactericide.

1 49. The method of claim 32, wherein the pore sealant is selected from  
2 food grade polymers, waxes and soluble proteins.

1 50. The method of claim 49, wherein the sealant is wax.

1           51.    The method of claim 32, wherein the sealant is sprayed onto the eggs.

1           52.    The method of claim 30, wherein while the eggs are in the gaseous  
2 atmosphere residual heat in the eggs increases the log reduction to at least 5.

1           53.    The method of claim 52, wherein while the eggs are in the gaseous  
2 atmosphere for about 1.5 to 3.5 minutes.

1           54.    The method of pasteurizing in shell chicken eggs, comprising:  
2               (1)    passing the eggs through a tank containing a heated fluid at  
3 different temperatures in separate zones of the heated fluid, said different  
4 temperatures being from about 139°F to 146°F in a first zone, from about 130°F to  
5 less than 135°F in a second zone and from about 135°F to about 138°F in a third  
6 zone; and  
7               (2)    removing the eggs from the heated fluid when the eggs have  
8 reached at least about 4.6 log reduction of any Salmonella within the eggs.

1           55.    The method of claim 54, wherein the log reduction is about 4.8.

1           56.    The method of claim 55, wherein the log reduction is up to 12.

1           57.    The method of claim 54, wherein the heated fluid is water and the eggs  
2 traverse the tank from an entrance end to a middle zone of the tank and to an exit  
3 end of the tank, and the first, second and third temperature zones corresponds,  
4 respectively, thereto.

1           58.    The method of claim 57, wherein near a bottom of the tank a plurality  
2 of jets is dispersed through which a jet fluid is passed from the jets into the water.

1           59.    The method of claim 58, wherein some of the jets are arranged  
2 transverse to a major axis of the tank.

1           60.    The method of claim 59, wherein one series of the transverse jets is  
2 spaced a part along the major axis from another series of transverse jets.

1           61.    The method of claim 60, wherein the jet fluid rises vertically in the  
2 water and to at least near a top of the water to provide a jet fluid wall in the water  
3 near each of the spaced apart series of jets, and between two such jet fluid walls a  
4 jet fluid walled compartment is formed.

1           62.    The method of claim 61, wherein there are at least two walled  
2 compartments along the major axis and the at least two walled compartments are  
3 maintained at the different temperatures.

1           63.    The method of claim 58, wherein the jet fluid is a gas or liquid.

1           64.    The method of claim 63, wherein the gas is air and the liquid is water.

1           65.    The method of claim 62, wherein there are an entrance compartment,  
2 a middle compartment and an exit compartment and the lengths along the major  
3 axis of the tank of the entrance compartment is from 0.1 to 0.3 the length of the  
4 tank, the middle compartment is from 0.3 to 0.7 the length and the exit compartment  
5 is from 0.1 to 0.3 the length and the temperature within each of the compartments  
6 corresponds to the different temperatures, respectively.

1           66.    The method of claim 65, wherein the length of the entrance  
2 compartment is from about 0.1 to 0.2, the middle compartment is from about 0.2 to  
3 0.6 and the exit compartment is from about 0.1 to 0.2 and the respective  
4 temperatures are from about 141°F to 142°F, 133°F to less than 135°F and 136° to  
5 137°F.

1           67.    The method of claim 54, wherein after the eggs are removed from the  
2 heated fluid, the eggs are passed into a gaseous atmosphere.



1           68.    The method of claim 67, wherein after the eggs pass into the gaseous  
2   atmosphere the eggs are contacted with an antibacterial fluid containing an  
3   antibacterial agent.

1           69.    The method of claim 68, wherein the antibacterial agent is any one of  
2   FDA Food Use approved bactericides.

1           70.    The method of claim 68, wherein the antibacterial fluid is contacted  
2   onto the eggs and is also contacted onto mechanical equipment handling the eggs.

1           71.    The method of claim 70, wherein the antibacterial fluid is sprayed onto  
2   the eggs and the mechanical equipment prior to the eggs contacting the mechanical  
3   equipment.

1           72.    The method of claim 68, wherein after contacting the eggs with the  
2   antibacterial fluid, the eggs are contacted with an egg pore sealant.

1           73.    The method of claim 73, wherein the pore sealant has an antibacterial  
2   agent therein.

1           74.    The method of claim 73, wherein the antibacterial agent is a FDA Food  
2   Use approved bactericide.

1           75.    The method of claim 72, wherein the pore sealant is selected from  
2   food grade polymers, waxes and soluble proteins.

1           76.    The method of claim 72, wherein the pore sealant is at least  
2   translucent when applied to the eggs.

1           77.    The method of claim 72, wherein the sealant is wax.

1           78.    The method of claim 72, wherein the sealant is sprayed onto the eggs.

2           79.    The method of claim 72, wherein after contacting the eggs with the  
3   sealant, the amount of sealant which remains on the eggs is at least equal to 85% of  
4   natural egg pore sealant removed from the eggs during the dwell of the eggs in the  
5   heated fluid.

1           80.    The method of claim 79, wherein the amount is at least 90%.

1           81.    The method of claim 67, wherein while the eggs are in the gaseous  
2   atmosphere residual heat in the eggs increases the log reduction to at least about 5.

1           82.    The method of claim 81, wherein the eggs are in the gaseous  
2   atmosphere for about 1.5 to 3.5 minutes.

1           83.    A pasteurized egg having an antibacterial fluid disposed between an  
2   egg membrane and an inside of a shell of the egg.

1           84.    An apparatus for pasteurizing in shell chicken eggs, comprising a  
2   support for the eggs and an application device in proximity to the support for  
3   applying to at least partially pasteurized eggs an antibacterial fluid.

1           85.    A method of protecting an at least partially pasteurized egg from rot  
2   bacteria while the egg is in a heated condition, comprising contacting the egg with  
3   an antibacterial fluid having an antibacterial agent therein.

1           86.    The method of claim 85, wherein the antibacterial agent is a FDA Food  
2   Use bactericide.

- 1            87.    The method of claim 86, wherein the bactericide is a quaternary
- 2    ammonium compound.